WATER-POWER IN THE MISSISSIPPI VALLEY[1]

BY MR. CALVIN O. ALTHOUSE,
Instructor in the Department of Commerce, Central High School, Philadelphia.

The first period in the history of manufacturing in the United States was that in which the streams of New England gave sites to small villages with single factories dependent upon water-power. During a subsequent period, coal was the concentrating factor. Industrial development in the near future will again depend largely upon water-power. But that water-power is a resource which man can easily dissipate has not yet struck home. The advantage of electricity as a means of transmitting and applying power so developed is furnishing a mighty stimulus to this development.

It has been estimated that in the South the slopes adjacent to the Appalachian highland are capable of developing 3,000,000 horse-power, and that in three states, North Carolina, South Carolina and Georgia, more than 90,000 horse-power has been developed in cotton mills alone. A tremendous aggregate of power is dispersed along the upper water of the streams and their hundreds of tributaries which find outlet into the Ohio and Mississippi rivers. In estimating the resources of the region, all these smaller powers should be counted in, for they can supply power for local industries, for lighting small towns and for transportation on local lines.

In the highlands which send their streams precipitously into the Tennessee, the Cumberland and the many other streams merging into the Ohio and finally the Mississippi, two general plans of improvement suggest themselves for utilizing the water:

(*a*) By building high stone and concrete dams, 20, 50 or even 100 feet high across the narrow gorges with wheel pits at or near the dam, and the construction of power houses immediately above the wheels. In this manner a fall of water equivalent to the height of the dam is obtained, and the steep descent of the channel below the dam assures the quick removal of the water from beneath the wheels.

[1]The paper discusses the possibilities of developing water-power in the Mississippi Valley, and locates many of the power sites, but not all of them.—EDITOR.

(*b*) Constructing lower dams, and conveying the water either through open canals or closed pipes for a distance along the banks of the stream until a sufficient fall can be obtained, at which point the power house is constructed.

In mountainous regions generally, many of the available sources are remotely situated and not within easy reach of railroads or good wagon roads. Again, in many instances, the gorges are so narrow and the country so rough that the local conditions are not favorable to the establishment of adjacent manufacturing plants. Hence, the necessity of transmitting the power electrically to points on the railroads where locations for the establishment of manufacturing plants and transportation facilities are within easy reach.

The location of many of our manufacturing towns has been decided by desirable and ample water-powers, or the abundance and cheapness of fuel without regard to nearness of raw materials, or the markets for the finished product. Therefore, as the item of cost of labor lessens by use of improvements in machinery and methods of manufacture, the item of cost of transportation constitutes a larger percentage of the cost of the finished product; hence, the question of conveying the power to the material or conveying both power and material to some advantageous point grows in importance.

Conveyance of power by the older form of belting and shafting was not only extremely local and inefficient but on the inside of buildings was regarded as unsanitary, more costly to operate and occupied too much room. Then, too, this method lost from 40 to 50 per cent of its power, whilst electricity loses only from 10 to 18 per cent in transmission. Electricity transmitted not in excess of forty or fifty miles will cost, regarding all the elements of installing wheels, generators, switchboards, etc., from $16.00 to $40.00 per horse-power, while steam, under similar conditions, is estimated at from $45.00 to $70.00 per horse-power. Electrically transmitted power has undisputed advantage for manufacturing purposes, and it will be a tremendous factor in developing non-utilized water-power, making industrial communities where none exist, and giving wider horizon to cities already feeling the quickened pulse beat of new commercial life.

Were the flow of the rivers constant throughout the year the problem of hydro-electric power would be comparatively easy, but

as changes occur it becomes necessary for us to bear in mind the difference between "ordinary low flow" and "average flow."

Ordinary low flow is intended to represent the average flow during a period of twenty or thirty days in the late summer or fall, when the river is lowest. A record taken for a period over five years shows the month of lowest stage to be September.

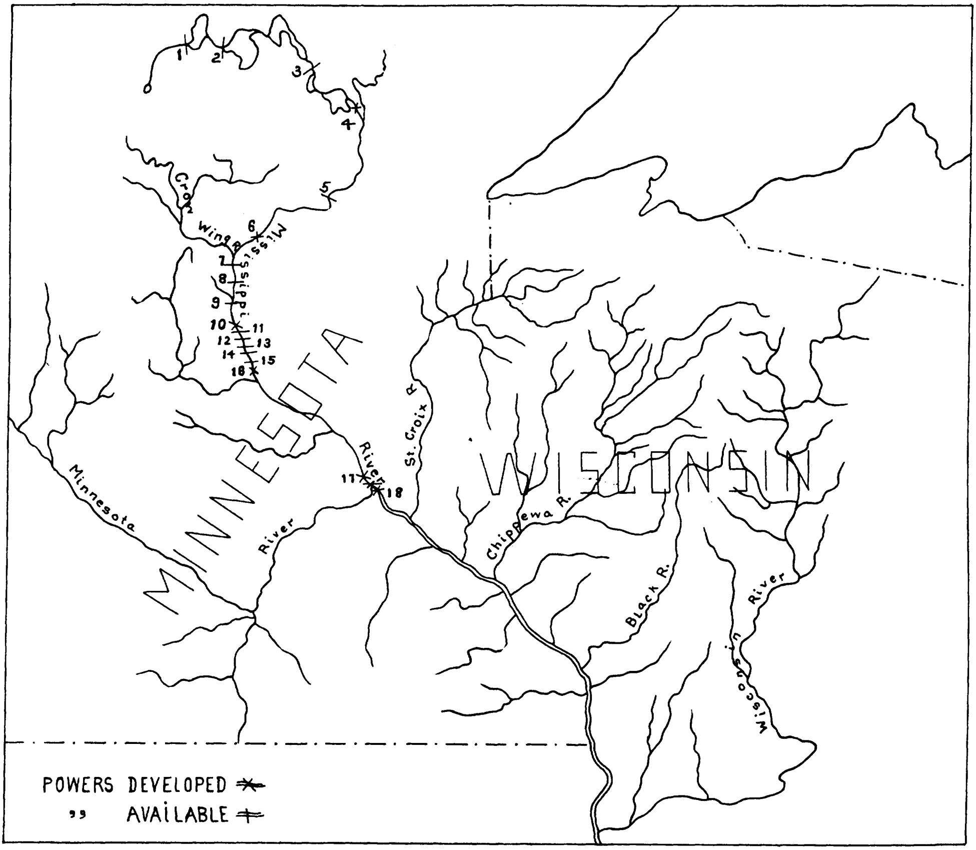
Average flow represents the stage of the river assuming it to remain constant from one day to another all the year through. It is practically the actual condition that would exist if a perfect and uniform system of reservoirs was applied throughout the Mississippi Valley, so that the floods could be held back and distributed during the low-water seasons. This question of average flow is of great importance in considering water powers.

Already, as a result of the transmission of power by electricity, the tendency in the cotton mills of the South is toward building larger and more efficient plants instead of the many small mills using the water powers direct. As in the seaboard region of the South the use of water powers has developed rapidly and established marvelous industrial changes, so we may anticipate similar transformation in the valley of the Mississippi.

The Mississippi River System

The drainage area of the Mississippi is estimated variously from 1,261,000 square miles to 1,390,000 square miles; the length, from mouth to source, if Lake Itasca be regarded as its beginning, is 2,616 miles, while from the mouth to the source of its greatest tributary, the Missouri, it is estimated as 4,200 miles. Its average width is 1,000 feet, but in the lower reaches of the river it varies from one-half to three-quarters of a mile, and at flood season it is far in excess of these latter figures. The maximum depth of the channel in the lower half of the river is from 60 feet to 125 feet at the mouth. The maximum flood level is about fifty-two feet above low water on the lower section, diminishing to fifteen feet at the mouth. The source of the Mississippi is 1,680 feet above sea level. The average total discharge from the basin is 675,000 cubic feet per second.

The major axis of the basin is 1,700 miles long, extending southeast from the northwest portion of Montana, through the Dakotas, Nebraska, Missouri, and Tennessee, down



1. Benidji.
2. Cass Lake.
3. Pokegama Falls.
4. Grand Rapids.
5. Big Eddy Rapids.
6. Brainerd.
7. Olmsted's Bar.
8. Conradi's Shoals
9. Elk Rapids.
10. Little Falls.
11. Pike's Rapids.
12. Cashe's Rips.
13. McDougal's Rips.
14. Blanchard's Rips.
15. Watab Rapids
16. Sauk Rapids.
17. Minneapolis.
18. St. Paul.

into the northwest corner of the State of Alabama, with one arm going off northeast into the Allegheny Mountains. The basin takes in practically thirty states and a part of the Dominion of Canada. With regard to areas drained and the actual volume of the streams the basin may be divided into four grand divisions: The Missouri basin, the basin of the Arkansas and Red rivers, the Ohio basin, and the basin of the upper Mississippi.

From the west toward the east the land slopes south and east from an elevation of 4,000 to 6,000 feet at the base of the mountains, diminishing to less than 1,000 feet at the Mississippi. In the eastern section, a large portion is but slightly elevated. In eastern Kentucky and Tennessee occur the Cumberland plateau and other tablelands. The average elevation is from 500 feet, in southern Illinois and Indiana, to 800 feet in the northern portions of these states. The average elevation of Ohio is about 1,000 feet. In Kentucky and Tennessee the surface varies from 300 feet, near the Mississippi, to from 600 to 1,000 feet in the central portions. On the Cumberland plateau the height averages 3,000 feet, and in the East Tennessee Valley from 600 feet to 2,000 feet. The average elevation in the immediate region of the sources is from 1,200 to 1,600 feet in Minnesota and Wisconsin. The lay of the land is particularly well adapted to the development of water powers in the upper regions of the rivers of the Mississippi system. There are not a few conspicuous places where tremendous power can and is being developed. There are many lesser sites which, when taken together, make an astounding aggregate.

Available Power on Upper Mississippi

From Lake Itasca to Lake Bemidji there is an average fall of nine feet to the mile, the power under a head of ten feet at an ordinary low stage above Lake Bemidji is estimated at eighty-seven theoretical horse-power, enough to run a good-sized custom mill. Below this point is to be found another site between Lake Bemidji and Cass Lake, where 220 to 475 horse-power could be developed. Two other powers of sufficient importance to command notice are found in the next stretch of 326 miles, namely, at Pokegama Falls and Grand Rapids.

At Pokegama Falls the development of from 1,170 theoretical horse-power to 2,477 theoretical horse-power is possible, which,

with increased height of dam could be increased ultimately to 5,200 horse-power. This power is usable for most of the year. At Grand Rapids a dam of six feet could be built, which would not interfere with Pokegama Falls, and develop, under varying conditions, from 700 to 1,500 theoretical horse-power.

From Grand Rapids to Little Falls, a distance of 220 miles, there is no concentrated descent which could be rendered available. Immediately above Little Falls there are several rapids which, under improved conditions, would render appreciable quantities of power. At Big Eddy Rapids it would be possible to develop from 2,200 to 5,000 theoretical horse-power, depending upon the flow. Just four miles above Brainerd, on the Northern Pacific Railroad, is another vantage point where a drop of some four and a half feet is found in a distance of 4,100 feet; the stage of the river under similar conditions is slightly greater than at Big Eddy Rapids, so that practically an equivalent of power might be produced.

At Olmsted's Bar, about eleven and one-half miles below the junction of Crow Wing River with the Mississippi, is the possibility of from 3,780 to 8,630 horse-power. Conradi's Shoals and Elk Rapids, between Olmsted's Bar and Little Falls, afford opportunity for the production of several thousand horse-power, it being suggested that the aggregate would exceed that at Olmsted's Bar, or in excess of 8,000 theoretical horse-power. At Little Falls, 106 miles above Minneapolis by water and ninety miles by rail, the river has a descent of 7.3 feet in 2,100 feet. The configuration of the local surroundings is such that at the bottom of the falls the banks on either side of the stream range from twenty feet to twenty-seven feet above the surface of the water.

A number of years ago several mills were operated at this location, but those in charge chose rather poor sites, letting the excellent place at the crest of the falls go by default. The stream here has been pronounced navigable, and the consent of the government would be necessary before a dam could be built, but this could be easily arranged by providing sluicing for logs and perhaps a lock for steamboats and barges. With a dam of ten feet 3,951 theoretical horse-power would be obtained under ordinary low flow, and with average flow 8,696 theoretical horse-power. By raising the dam to sixteen feet and concentrating effort at this point, power to the extent of 14,500 horse-power could be developed, but it

might impair Elk Rapids above, which would produce in the neighborhood of 3,000 horse-power. The difference would be such, however, as to favor Little Falls.

From Little Falls to Sauk Rapids, thirty-one miles distant, the descent of the river is rapid, the average slope being 3.1 feet per mile. The chief points of concentration are Pike Rapids, Cashe's Rips, McDougal's Rips, Blanchard's Rips and Watab Rapids. It has been proposed to build dams, one at Cashe's Island, with a head of thirteen feet, and another at Blanchard's Rips, with a head of ten feet. The first would probably flood back to Pike Rapids and the second to about the foot of Cashe's Rips. The flow being essentially the same here as at Little Falls, the ordinary low flow would produce, under three feet head, 5,136 theoretical horse-power, and under ten feet, 3,951 theoretical horse-power; with the average flow the result would be respectively 11,660 horse-power and 8,696 horse-power. The total fall from the head of Little Falls to Sauk Rapids is ninety-five feet, and there are several places, according to James L. Greenleaf, Assistant Professor in the School of Mines, Columbia University, New York, where utilization of power could be made at little cost.

In the stream between St. Paul and the headwaters dams now exist at the following places: One between St. Paul and Minneapolis, two at Minneapolis, one at Watab Rapids, one at Little Falls, one at Brainerd, one at Grand Rapids. And Congress has authorized in addition; one between St. Paul and Minneapolis, one at Ostego, one at Monticello, one at St. Augusta, two at Sauk Rapids, one at Pike Rapids, one at Bemidji. Also one on the Crow Wing River below Gull Lake.

The influence of the reservoirs at the headwaters on the water powers and what they mean to the states interested cannot be adequately treated here, but they must be considered briefly. Their prime purpose is in steadying river discharge to prevent abnormal flow, or at least minimize the occurrence and to furnish ample flow in the dry season. The five reservoirs established by the United States in Minnesota between the years of 1884 and 1895 have, during the period of their operation, been of inestimable value. They have cost a million and a quarter of dollars to build and maintain. They store ninety-six million cubic feet of water. From an estimate recently made the manufacturing of Minnesota

is benefited to the extent of $13,000 for each billion cubic feet of water so stored. The influence, therefore, of those existing and of the balance of the original number projected, forty-one, which ought to be made operative, is tremendous, and affects the whole question of water powers on the Mississippi proper.

The Mississippi River above St. Paul, as shown, is exceedingly well adapted to water-power purposes. The banks are generally high, making flowage rights comparatively inexpensive; the bed is generally firm, making foundations comparatively easy; the slope of the river is exceptionally steep, making mill sites numerous; the total fall from Grand Rapids to St. Paul is about 578 feet, and a reservoir system at the headwaters of the river greatly increases its low-water flow.

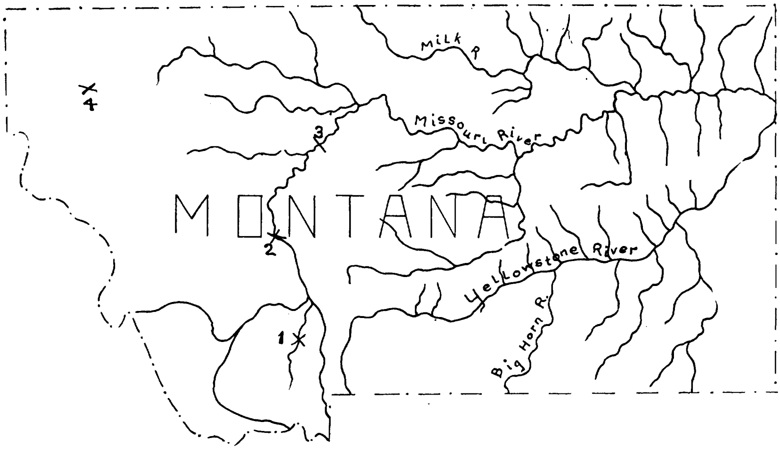
At Minneapolis the river has a utilized head and fall of sixty-eight feet, which is divided into two parts. At the upper falls are located all the flouring mills and other industrial establishments; at the lower falls is the electric plant. The utilized power, in 1906, at St. Anthony Falls was 40,000 horse-power, while plans under consideration will increase this from three nearby sources by several thousand horse-power. At Keokuk, Iowa, plans are under way, by the Hamilton Power Company, to develop an immense power plant which will create 200,000 horse-power. Few available sites exist below this point, on the Mississippi proper, but numerous and valuable water powers exist on the two great branches tributary to the Mississippi, on the Missouri and the Ohio and its branches.

Power on the Missouri and Tributaries

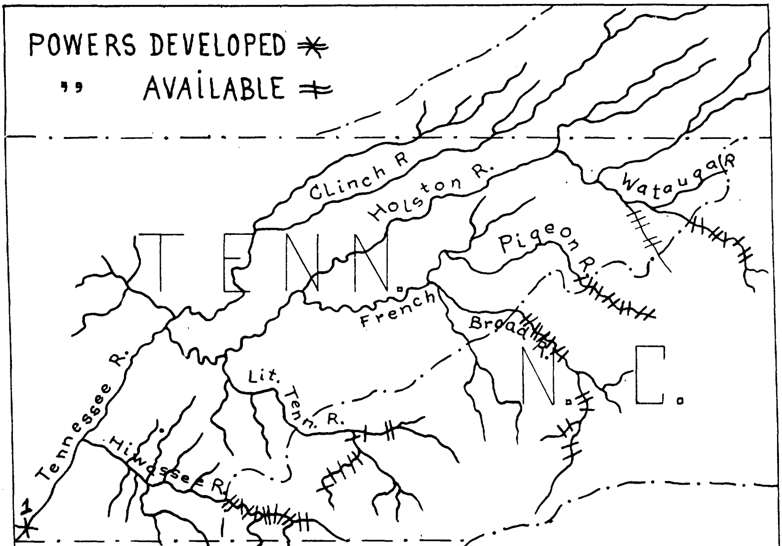
Difficulty in getting accurate and complete data for the Missouri exists, because few of the states adjacent to its course have done anything along this line. However, much valuable information is at hand from the State of Montana which shows what the Missouri may furnish in the future.

In 1898 the Madison River Power Company began the construction of a plant which was completed in 1902. It is located on the Madison River Canyon, near Red Bluff, sixty-five miles from Butte, to which latter place the current is brought for commercial use. The transmission is by aluminum wire with from 40,000 to 80,000 volts. The cost was approximately $300,000.

The Big Hole Electric Power Company is located on the Big



1. Red Bluff.
2. Canyon Ferry.
3. Great Falls.
4. Kalispell.



1. Chattanooga.

Hole River, twenty-seven miles from Butte, on the Oregon Short Line Railway. The dam is fifty feet high and about 500 feet long on the crest. Four thousand horse-power is developed and sent to Butte across country at 15,000 volts. This plant was started in 1897 and completed in 1900, the cost being estimated at $800,000. In the northwestern end of the State of Montana another successful power company is in operation. Near Kalispell, on the Big Fork River, is the plant of the Big Fork Electric Power Company. Here the fall from the surface of the water in the receiving basin to the base of the wheel pit is 109 feet. A capacity of 1,350 horse-power is developed, the plant having cost $150,000. The demand for the power from this plant has been such as to compel the company to take steps to increase its output.

The Missouri River Power Company has its present power house located on the Missouri River about twenty miles almost directly east of Helena, at the little town of Canyon Ferry. At the mouth of the canyon a dam 480 feet in length has been thrown across the stream, designed to give a thirty-foot head of water. One of the peculiarities of this special body of water is, that though the water may freeze in a lake a short distance back from the canyon, the water flows to the power house as free from ice in winter as in summer. Here is developed 10,000 horse-power, all of which is consumed, and the demand is greatly in excess of the supply. Helena, twenty miles away and East Helena fourteen miles away, receive their supply from this point, and recently power has been transmitted to Butte, sixty-five miles away. This plant is distinctive in that it transmits power successfully at the high pressure of 50,000 volts.

Last year Congress granted to another company, the Missouri River Improvement Company, the right to build a dam below the Great Falls of the Missouri, and about fourteen miles down the river from the City of Great Falls. What power will be developed here is yet a matter of conjecture, but it bids fair to eclipse the largest yet developed in Montana. Little information exists as to present available sites, but a glance at the region will indicate that the resources have just been touched. At Sioux Falls and other points along the Missouri and its tributaries various projects have been broached. As we come down out of the foothills the even trend of the prairie precludes water-power in the lower reaches of the river.

The Ohio and Tributaries

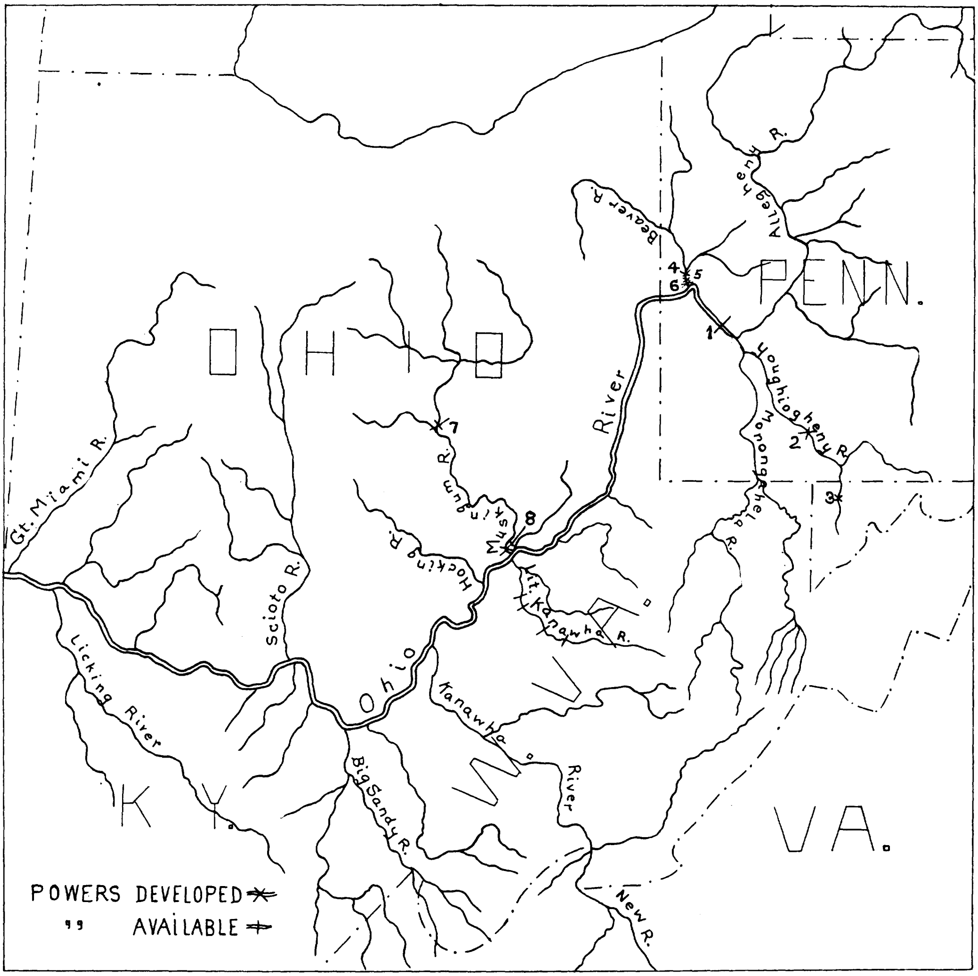
By the union of the Monongahela and Allegheny rivers at Pittsburg the Ohio River is formed, with a drainage area above that point between 18,000 and 19,000 square miles. Its drainage basin totals 214,000 square miles.

The principal streams contributing to this area are: on the north side, the Beaver, Muskingum, Scioto, Great Miami and Wabash rivers, and on the south, the Little Kanawha, Great Kanawha, Big Sandy, Licking, Kentucky, Green, Cumberland and Tennessee. These streams give to the Ohio system a vast range of territory and make it tributary to the larger part of the western Appalachians, all the way from New York down into Georgia and Alabama.

Mr. Dwight Porter states in the seventeenth volume of the census report of 1880 that there is "no question that, in their upper courses, above the limits of navigation, the various tributaries on the south side of the Ohio and their own affluents, present in the aggregate much available water-power. Those to the north of the Ohio are already largely in use, and will admit of much further development." It was originally thought that the powers in this region were individually of no great magnitude and suited, therefore, only to small manufacturing, but when we see 50,000 to 60,000 horse-power plants going up on the stream hitherto regarded as of little consequence we are compelled to revise authorities of twenty years' standing.

One of the chief disadvantages to-day to the fuller utilization of the streams, especially on the north side of the Ohio, is the insufficient supply of water in summer and fall, and the heavy freshets; by engineering skill these objections are being met, and the policy of afforestation will also aid. The principal use of power on these rivers to date has been for flouring, grist and saw mills, but on certain rivers, notably the Great Miami and the Beaver, general manufacturing has established itself.

The Ohio River *per se* presents few opportunities for the development of water-power, the two really available sites being at Louisville and Davis Island Dam. Engineers estimate that from 17,000 to 144,000 horse-power can be produced at Louisville Falls, 600 miles below Pittsburg and 135 miles below Cincinnati. As early as 1873 plans to this end were presented utilizing



1. Davis Island Dam.
2. Connellsville.
3. Falls City
4. Beaver Falls.
5. New Brighton,
6. Fallston.
7. Zanesville.
8. Marietta.

the present government dam and canal. On the Indiana bank of the river a low wing dam of rip-rap diverts enough water to run a few small plants situated above on the bluffs, and a trifling use of power is reported also on the Kentucky side. Many objections have been raised, but the main project is entirely possible if sufficient capital would develop the site.

At Davis Island Dam, a few miles below Pittsburg, it is suggested that from 3,000 to 4,000 horse-power could be developed on an average of from seven to eight months a year, by taking advantage of the ten-foot fall below the dam as now constructed. The two outer branches of the Ohio, viz., the Allegheny and Monongahela-Youghiogheny furnish, comparatively, little power. On the Allegheny there are a few powers, ranging from 75 to 250 horse-power and one of 570 horse-power. With the improvements now being made in the generation of hydro-electric power, however, these conditions may be improved. The Monongahela is essentially a navigable river all the time, the aim of the coal companies being to get their barges down to Pittsburg, thence on to the West and South. There are a few powers, none in excess of seventy horse-power, however.

Water powers are utilized to a greater extent on the Youghiogheny River, there being two points at which use is made of electric power.

Connellsville, in the center of the great coke region of Pennsylvania, develops from 70 to 170 horse-power; while fifty-six miles from the source, at Falls City, where a thirty-four foot fall is found, from 350 to 900 horse-power is used. On the Beaver River, at Beaver Falls, there is developed, under a head of nineteen feet, from 650 to 1,510 horse-power. At New Brighton and Fallston, on the same river, from 600 to 1,400 theoretical horse-power is produced.

The Muskingum River, taking in the greater part of eastern Ohio, has eleven state dams constructed from which power is leased for thirty years at a time for so much per cubic foot per second per annum. On this stream the two more important points are Zanesville, 966 horse-power, and Marietta, where 900 horse-power is developed. The Little Kanawha furnishes small sites developing from 12 to 215 horse-power with an average of 35 horse-power. On the Great Miami water powers have been util-

ized for years, the estimated power now being developed in the valley is placed at from 8,000 to 9,000 horse-power.

The Upper Tennessee

To the south the Tennessee River furnishes tremendous possibilities. Rising in the foothills of the Blue Ridge Mountains and cutting through the Appalachian system by many tributary streams, the story of the Tennessee is the account of its tributaries to a large extent. Above the Tennessee line the drainage basin is about 1,831 square miles. From Georgia into North Carolina the stream is rather sluggish, but from beyond Franklin, North Carolina, it goes through rocky gorges with a descent of from ten to forty feet to the mile. A few water powers are in use here, but the possibilities are enormous. One of the principal tributaries of the Tennessee, the French Broad River with its many affluents, furnishes admirable sites in its passage through the Smoky Mountains and the smaller ranges to the westward.

Through the upper counties, near its origin in North Carolina, the river passes through a deep narrow gorge, from which power developed could be carried back into a rather rich country. Below this section are numerous falls where, according to the report of the state geologist, "water powers of great magnitude" can be developed. Lack of data as to flow of the stream prevents expressing this condition in figures of measurable value.

The Watauga River, another tributary to the Tennessee, is described as being everywhere a rapid one, for the most part running through a deep narrow gorge with rock bottom and rock sides, thus furnishing at many points excellent facilities for the construction of dams. The fall of the stream from the Tennessee line, a distance of some nineteen miles, is 900 feet, the average fall per mile being about forty-seven feet, hence the matter of utilization becomes merely a matter of convenience.

All told, there are about ten available first-class water-power sites on the thirty miles of the stream. At the mouth of Beech Creek, about four miles above the state line, there is an especially fine site where, from the report of the geological survey for North Carolina, it is said almost any desired power can be generated. Thousands of horse-power are unutilized on the comparatively small reach of this powerful stream.

The Toe River furnishes another admirable source of power. This stream, some forty-five miles in length, offers nine available water-power sites, and a projected and partially completed railroad follows the river sufficiently near to make the latent water powers accessible. Gaugings taken show that the flow is of such a nature as to develop from sixty-six to ninety horse-power per foot of fall throughout the region where the available sites exist. The South Toe furnishes seven available sites, one of which has a fall of 3.5 feet in 100 feet, over a ledge of coarse granite, at which point the stream is fifty feet wide and where ample space exists for buildings. Another branch, the Caney River, gives eight sites for power usage, and the character of the stream, flowing through a deep narrow rock-bound gorge, makes dam building easy.

The Pigeon River, some fifty-five miles in extent, joining finally with the French Broad, through the major part of its course has a fall of twenty-six feet to the mile. It furnishes four excellent sites and the surrounding country is such that by transmission it would furnish power to towns on the Western North Carolina Railroad, and to one or two other larger towns, notably Waynesville. Numerous other powers are found on the Hiwassee, where thirteen are available; the Cheowah with seven; the Tuckaseegee with seventeen; the Little Tennessee with nine, and the New River with fifteen.

One of the most remarkable evidences of the growth of hydro-electric development is to be found in the recent project for the building of a plant at Chattanooga, Tennessee, which will develop 52,000 horse-power.

All through this region evidences of the increased use of this resource is to be seen. The Cumberland River in the upper reaches above Nashville furnishes several ample sites for power which, if developed, would, by transmission to Nashville and other river points, aid in swelling the $10,000,000 worth of trade which is annually carried on this stream.

Enough has been detailed to demonstrate the mighty force now unused in the great valley of the Mississippi. The maps show that the powers are concentrated in four general centers, each of which has its significance. In the Missouri or Montana district the power to-day is being used to light cities, operate urban railway lines, run copper smelters, for local manufacturing and for mining. As

a factor in city life and growth it is of the greatest importance. Comparatively cheap power will furnish a stimulus to the production and manufacture of the minerals mined, give cheaper and more frequent transportation facilities, allow of the growth of cities and provide a basis for new communities.

Capitalized at $16.00 per horse-power per annum it is conservatively estimated that from $64,000,000 to $70,000,000 worth of hydro-electric power is annually going to waste in the Mississippi system.

The rise of Minneapolis as a milling center has been largely due to her natural site where she enjoys an unusual power advantage. The present total valuation of water-power developments in operation on the Mississippi River between Minneapolis and the reservoirs, including mills, factories, electric-light plants and other industrial establishments depending upon water-power can safely be estimated at $2,250,000. There are now building and in process of construction water-power developments above Minneapolis to the value of $1,000,000. Five large power plants are under consideration at the estimated value of nearly $3,000,000.

In the region of the twin cities of Minneapolis and St. Paul the annual value of flour out-put from mills using water-power is $58,300,000, feed $6,700,000, woolen goods manufacture $500,000, electric light and power $800,000, with sundry other products totaling some $67,000,000. The aggregate value of flour mills, factories, woolen mills, elevators, shops, etc., reaches the neighborhood of $18,000,000, with the approximate annual pay-roll of $3,500,000.

The increased use of our natural resources in this section will mean our greater ability to compete with the foreign flouring and milling industries, enable us to develop to a greater extent our agricultural regions, to increase our manufactured products and enable a larger population to live in the region tributary to the upper Mississippi.

As copper and general mining will be benefited in the northwest, flour and general manufactures in the Minneapolis region, so coal, pottery, iron and steel, cutlery and general manufactures would be benefited in the Ohio River region. It is claimed that much of the manufacturing supremacy of eastern Ohio has been due to her cheap water-power. In the southeastern part of the

system on the west-Appalachian region there is immense possibility, but as yet there has been little development.

Chattanooga, Tennessee, has a bright prospect with the development of the proposed 52,000 horse-power dam—this is going to mean much to the agricultural implement business and cotton manufacturing throughout the South. The lumber and cotton industries will have a tremendous impetus given them, while better lighted cities and better transportation facilities will give a new horizon to the people. Cheap power, and long-distance transmission with its increased output under more desirable conditions than at present, concentration of production, better civic conditions, in what are now practically isolated rural communities will come as the consequence of our fuller appreciation of this valuable but inadequately utilized resource.